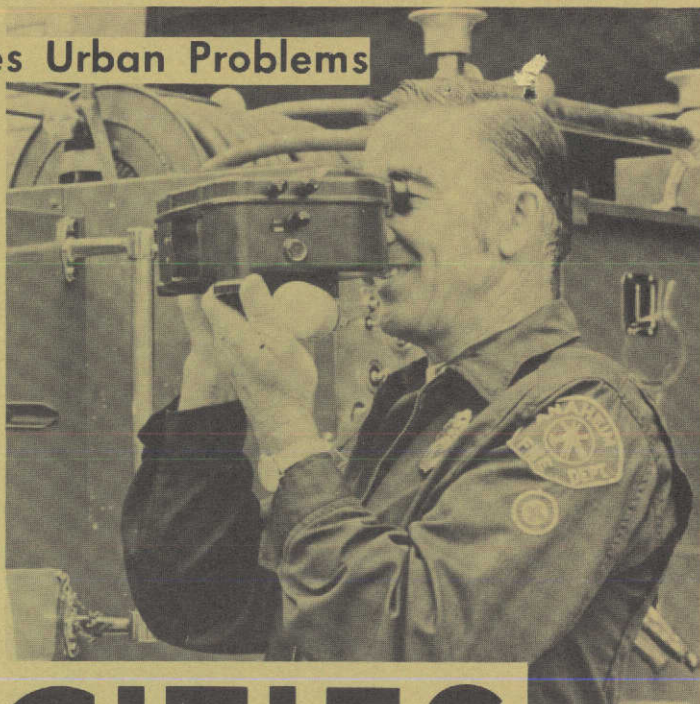
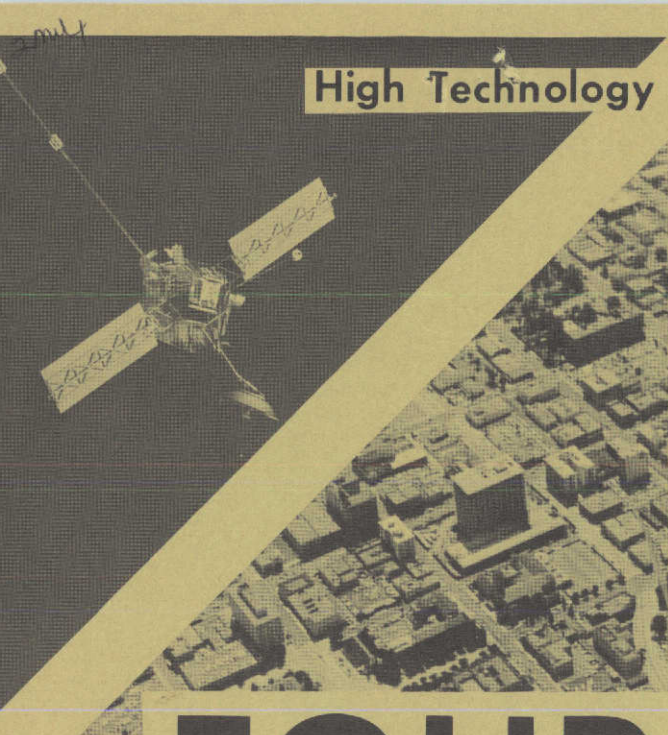
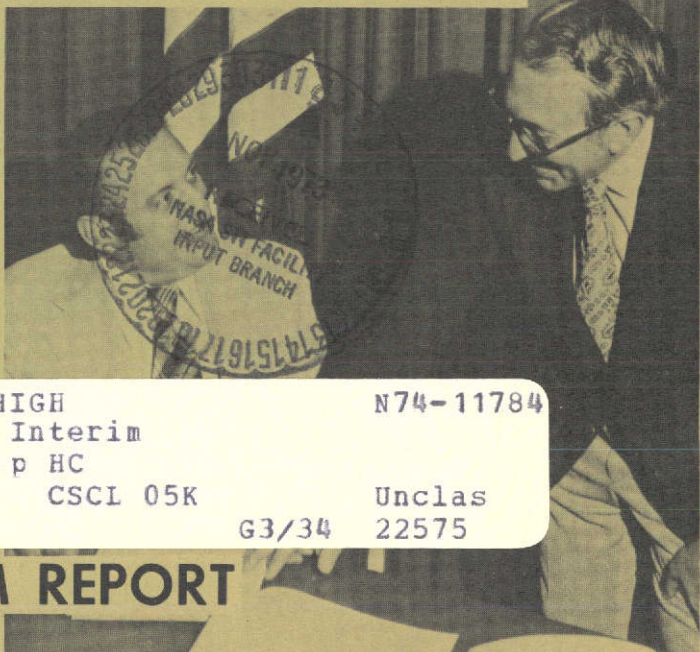


High Technology Faces Urban Problems



# FOUR CITIES



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## AN INTERIM REPORT



## Preface

The Four Cities Program represents a new approach in the application of technology to domestic needs and a new use for part of what has been learned in recent decades in systems engineering and management. Begun as an exploratory investigation of technology transfer to city management, it has become a continuing demonstration of the teamwork approach in discovering, organizing, communicating, and operating new solutions to urban problems. Each of four project teams pairs a city government with a high-technology or aerospace firm, with the main effort carried by a senior scientific or engineering professional from the company who serves as Science and Technology advisor to the City Manager.

The Program is sponsored by the National Science Foundation's Intergovernmental Science and Research Utilization Program and NASA's Technology Applications Office, and coordinated and managed by the Jet Propulsion Laboratory. Both the Laboratory and the four participating companies provide technical support as required.

The new approach employed in the Four Cities applies the skills of the technologist not only to technical problems of urban society, but to the study of the total process of technology transfer as well. This process, which stretches from the sources of new technology through media of communication and publication to application by the user and the

assessment of results and ramifications, has long needed thorough study. The work in problem identification and project definition and management applied to urban matters by the Four Cities teams breaks new ground in this field. The discovery of major unmet urban needs in the system management area is also a significant one, and the continuing improvement in the definition of fields of application for development and management technology is of general benefit to the research and development industries. The new techniques, devices, and approaches made available to city management, and the evidence of willingness on the part of technologists to help cities solve their own problems on their own terms offers promise to urban leaders.

It appears that this Program has met its initial goal of testing the thesis that direct urban-technological collaboration is productive. The development and demonstration of new modes of teamwork, together with the articulation of long-term technology projects in the cities and the definition of new tasks, have become the principal activity. There remains much to do in consolidating past gains and discovering and proving new techniques of matching society's needs to its skills. Yet Four Cities has reached what we might call the end of the beginning, in showing the ability of professionals from city management and high technology to work together to make our society work better



W. H. Pickering  
Director, Jet Propulsion Laboratory

### Acknowledgements

This report is based partly on observation of project participants at work but principally on material provided by them and the institutions they represent. The authors particularly thank M. F. Hersman, J. Holmes, G. S. James, and B. Reiss of NSF's Intergovernmental Science Program, M. E. Alper, L. S. Blomeyer, G. Brighthouse, R. T. Diehl and E. S. Salvson of the Jet Propulsion Laboratory, and most of all the four city teams: Anaheim/Bill Armstrong/Northrop, Fresno/Mike Licciardello/Science Applications, Pasadena/Forrest Warren/Aerojet, and San Jose/Jerome Weiss/Lockheed. The observations, findings, conclusions, recommendations, etc., of the report, however, are those of the authors, and not necessarily those of the sponsors, cities, companies, or named individuals who have made it possible. Sources of photographs are credited elsewhere.

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High Technology Faces Urban Problems:

## FOUR CITIES

An Interim Report

James H. Wilson and  
Harold L. Macomber

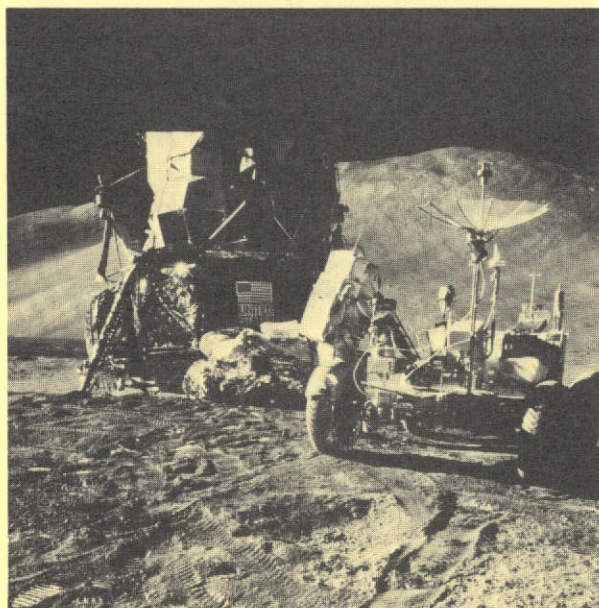
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*Designed by Frank J. Licher*







## I. GATHERING

The Four Cities Program is an experimental, organic response to a number of major challenges in contemporary urban society. Under the formal title, "A Pilot Demonstration Project of Technology Application from the Aerospace Industry to City Management," it was proposed early in 1971 by the Civil Systems Program Office of the Jet Propulsion Laboratory. The Project was authorized by the National Science Foundation and the National Aeronautics and Space Administration soon afterward, and began in the Fall of 1971.

The challenges to which the Project might offer a response can be stated briefly only in oversimplified form. We the people are taking more out of urban civilization than we are putting in. Large and fast-growing research and development programs, sponsored by the Federal Government, have greatly advanced our military and aerospace capabilities, while domestic and particularly urban needs have increased without being met. One sector has excess capability, the other excess need. And by the 1970's national policy began to shift from Federal centralism toward localism.

The nature of the Four Cities experiment is truly simple: to test, in microcosm, technology's ability to serve urban needs, and the city's ability to use it effectively. One city paired to one aerospace company. One system manager or senior R&D scientist/engineer paired to one City Manager's staff. But each human being, each corporation, each city is unique. For a valid test and demonstration, and for the assistance and support they could give one another, four project teams were established, at Fresno and San Jose, in northern California, and at Pasadena and Anaheim, in Southern California. JPL was to coordinate and evaluate the effort, and provide additional technical help as needed. This interim report shows some aspects of the context, progress, and preliminary results of the enterprise.

### Technology versus the Good Life

It is mostly in or from the city that the adverse byproducts of technology confront us. Air, water, and land

pollution, noise and traffic, mass-produced sameness, overcrowding, Big Brother, and the horrors of modern war: these we identify with urban civilization. Alas, Babylon! In nature only the volcano and other natural disasters can compare.

To find the good life, we run away. For a little while we go away on vacation. To the beach where portable radios and booming exhaust pipes compete with screaming gulls and pounding surf. To the national parks where the lines of camping vehicles and station wagons awaiting entry would choke a freeway or toll bridge.

To escape permanently without cutting our roots we move out of town to suburban beauties, planting row upon row of houses where once orchards bloomed, commuting in massive phalanxes of automobiles. Even the desert is made to bloom with streetlights, signs, concrete, and waste dumps.

Some of us who are young enough to pursue radical ideals turn our backs entirely on the evils of civilization and assemble communes in the wilderness. We leave behind water pipes, power lines, sewers, and roads, but not the need for them. We grow our own corn, beans, chicken, and cannabis, but still we are not independent or self-sustaining. There is only enough wilderness for a very few of us.

In another dimension we vicariously reach escape velocity high above the Earth, land on the moon, map the planet Mars, and conquer space. But nowhere off the Earth do we find a place where we can live, let alone escape.

Meanwhile the city we have fled grows older and dirtier in the center, and bigger and more crowded at the edges. Corporate entrepreneurs redevelop the center to hold more offices, the edges to hold more homes and shopping centers, and the ring in between to carry more commuter traffic. More and more of the city is left to those who cannot escape it, such as the poor, the pensioners, the criminals, heavy industry, and the city administration.

We blame the city and run away as though the city were the cause and not an effect. We condemn technology and



run away (carrying it along) as though we do not owe to it the good life we enjoy and seek along with the pollution we abhor. We damn the politicians and civil servants and policemen who struggle with the problems we make for them.

## The Growth of Different Needs

City administrations face technology on two fronts. First, the adverse byproducts of industry pollute the urban environment long before the wilderness suffers, and the production and use of vehicles, electrical appliances, and other technology products puts growing demand on the city's roads, power lines, space, and waste disposal services, and on their public safety agencies. Second, the general growth of cities and of demand for urban services, outrunning the ability to provide staff and funds for these services, calls for greater efficiency and productivity in the city – a specialty of technology. The pollution potential of some technical changes has long been with us – the English Parliament restricted the use of sea-coal in the time of Henry VIII. Industrial dumping into European rivers was challenged early in the Nineteenth Century. But the far-reaching implications of advanced developments have often been overlooked at first, even in our time, as witness the SST and nuclear power controversies. Thus the cities have had reason to look upon technology as part of their problem – not part of the solution.

But they have also been keenly aware of the huge national investment in research and development, most of it directed toward military missions, the exploration of outer space, and the medical arts. This research and development has been glamorous in some of its results, rewarding for some of its practitioners, and notwithstanding a few dramatic instances, generally irrelevant to domestic needs. Cities which service and house the offices, plants, and laboratories which produce technical breakthroughs have reasonably asked for a breakthrough of their own. They must repair streets, fight fires and crime, deliver water and power, and remove waste by techniques which have improved little since the invention of the airplane or the jet engine, side by side with satellite communications, heart transplants, lunar landings, and the "smart bomb."

If the overworked managers of urban society have been left behind, advanced technology has begun to get a little too far ahead. The research economy is healthiest when it is growing, and it has grown mightily since World War II. Under

federal sponsorship, motivated largely by military-security demands, and more recently by the challenge to explore the solar system, the research and development industries have grown beyond industrial technology in scope and beyond the ability of their sole sponsor to support them. The time came when shifts in federal policy, or the completion of contracted projects, or procurement decisions, could result in massive layoffs and even corporate failures.

By the end of the 1960's and the beginning of the 1970's a major change in federal policy toward these two sectors of society became evident. It was called the New Federalism, and it sought decreased emphasis on purely federal sponsorship and remote goals for the R&D complex, and increased concentration upon more immediate domestic needs, under more local direction and, so far as possible, local sponsorship. This trend had been anticipated in the mid-1960's in California's four experimental system studies of civil problems, conducted by aerospace firms. In addition, various specific product developments, particularly of police equipment and fire-fighting vehicles, usually related to military technology, were completed.

But the technology going begging in the under-utilized aerospace industry, and seemingly responsible for most of the dramatic achievements of the large military and space projects, has little to do with police cars, fire engines, garbage trucks, or neighborhood improvement. It is as remote from turret lathes and telephone switchboards as it is from dams and sewers. Grounded partly in mathematical analysis and partly in the design and testing of complex weapons, aviation, communications, and space systems, this technique was first called "aerospace technology" after its best-known applications. This name was soon discarded as too narrow, and the more general, if possibly snobbish term "high technology" came into use.

The methodology which permitted researchers and developers to organize and apply new and adapted techniques in a missile or space project offered some promise for urban problems. At least some analysis and management techniques might be directly applicable. More important, the process of getting new technology to the cities and, once there, into service, might be susceptible to analysis. Trying out and demonstrating this approach was the fundamental new idea from which grew the activities described in this report. The willingness and interest of the project partici-



pants, institutional and individual, made it possible: the sponsoring agencies, companies, and cities provided funds, services, and supplies, and the individuals provided ideas

and energy. None was very certain what the project would accomplish. Few indeed were sure quite what it was, but they intended to learn.



*Project participants exchange views in Quarterly Review, Pasadena, Spring 1972.*

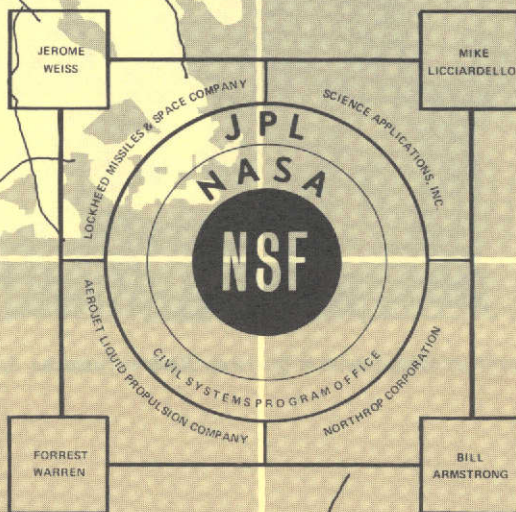


SAN JOSE

Manager: Ted Tedesco

FRESNO

Manager: Bruce Reiss



Manager: Donald McIntyre  
PASADENA

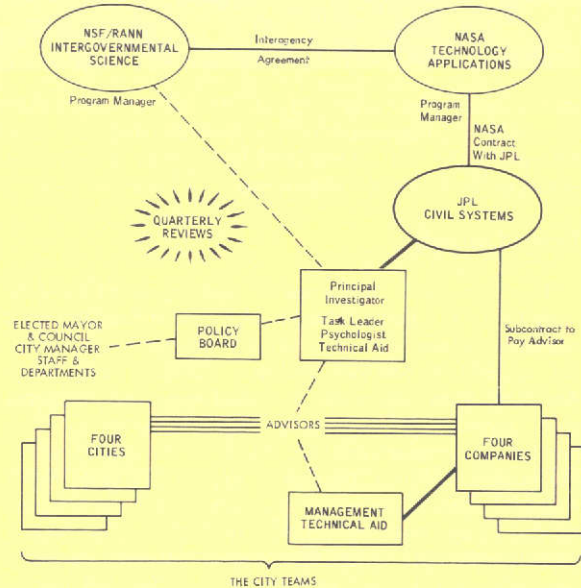
Manager: Keith Murdoch  
ANAHEIM



The earliest lessons were for the Program's organizers. Before the proposal was submitted they had found eager expressions of interest in the program, and pledges of commitment to its success, from the prospective city and company participants: the seedling idea found very fertile soil. The cities were not sure what specific accomplishments the program might provide, but they were willing to support it and find out.

1. Determine the ability of industrial aerospace professional to contribute directly in the environment of the cities at this level.
2. Determine the nature and amount of technical support required to implement a program to bring aerospace technology to local governments.
3. Expose City personnel to the "systems approach" and thereby enhance their performance through this educational process.
4. Expose aerospace personnel to the socio-political process in the cities to enhance their understanding of the cities' problems.
5. Assess the applicability of aerospace technology and expertise to problems of the cities.
6. Evaluate whether or not this type of arrangement is beneficial to the cities and to the aerospace industrial community.

Continuing discovery accompanies working progress together. The project team participants are still learning



*Institutional organization of Four Cities Program.*





Because of the exploratory nature of the program, the teams were encouraged to select and pursue pilot projects which would serve both to focus the learning and technology transfer process and generate products and progress to benefit the local city and city management at large. The format of the Four Cities activities was not specified rigorously. Both the companies in the field teams and JPL, the program coordinator, were to provide technical help when needed. The city administrations were to help pose problems, participate in all stages of progress toward solution, and provide logistical support.

The participants would gather regularly in quarterly review meetings held at each of the cities in turn, to



much about each other, about themselves, and about cooperation. These explorations, like the study of technology transfer, were recognized in the project objectives as part of the Four Cities experiment.

### Project Underway

Four tentative project teams were specified in February 1971: San Jose and Lockheed, paired at the company's suggestion; Fresno and TRW Systems, geographically remote but united by previous projects; Anaheim and North American Rockwell, a natural local pair; and Pasadena, soon joined by neighboring Aerojet's Space General. Because of changing corporate objectives and other reasons, Northrop, also with a Division in Anaheim, replaced North American; after a year with the program, TRW was replaced on the Fresno team by Science Applications, Inc.; and a reorganization put Aerojet's Pasadena activities under a corporate wing located in Sacramento. The San Jose — Lockheed team remains unchanged.

exchange ideas and report their activities. The four Advisors kept up a steady, irregular intercommunication, in which, as time progressed, JPL took an increasingly active role. One communicative enterprise was active from the very beginning, however. Since so much of what was to be learned and accomplished would take place at the interpersonal level, the project needed expert monitoring and evaluation of the evolving interactions and relationships. A professional psychologist with a background of studying industrial relations and management was necessary. Gilbert Brighthouse, emeritus Professor of Psychology, industrial con-



sultant, and amateur magician, undertook this role, interviewing, testing, travelling, and communicating with project participants.

The project teams which are working to carry out the aims of Four Cities are built from three kinds of institutions, local government, industry and a government-owned research laboratory. Industry provided the key person on each team, the Advisor, and the technical skill was provided by all three partners. The advisors' salaries were reimbursed by the program; the companies donated their technical and management support and the laboratory was supported by NASA.

Lockheed Missiles and Space Company has developed a broad capability and interest in civil information and data systems. As one example, as one of the California System Study Projects, LMSC performed a statewide federated information system study. In addition LMSC's management club had organized a volunteer project called SAGES (Scientific Assistance Group for Environment and Services), helping local

communities and school systems with technical problems. At the company's initiative, San Jose was invited to join Four Cities.

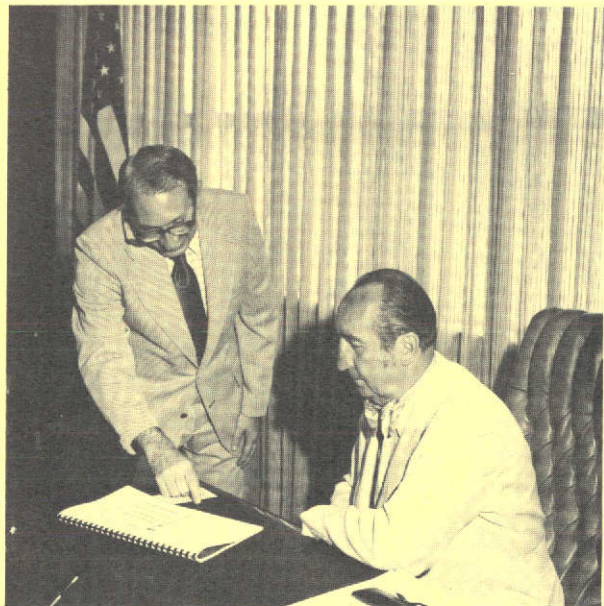
Jerome Weiss, the San Jose Science and Technology Advisor, managed or took part in many of Lockheed's previous civil systems projects. Trained and experienced in both the social and the physical sciences, he brought scientific perspectives and expertise to city administration. A big, soft-spoken New Yorker, Jerry Weiss approached his Four Cities assignment with a concern that city officials should not feel threatened by high technology and a gentle "slower is better" motto to aid the process.

Aerojet-General's corporate ancestor was founded by a group of Caltech-JPL scientists in Pasadena, and it has remained a Pasadena neighbor. Aerojet operating companies performed two California System Studies of 1964, examining the problems of waste management and the criminal justice system.

Forrest Warren, a veteran of Aerojet's Space-General, came to Pasadena's City Hall with a background in engineering management and satellite projects. A tall, crew-cut Westerner, Forrest has a subtle ability to work through others rather than above them, rendering the manager almost invisible and the team very effective. This method is very effective in reducing apprehension about new techniques. His previous assignment was to manage a project which placed frogs in orbit around the earth, a far cry from urban technology.

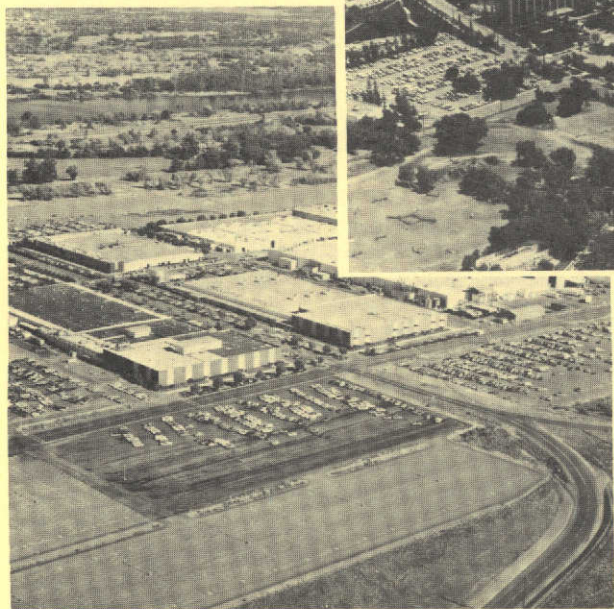
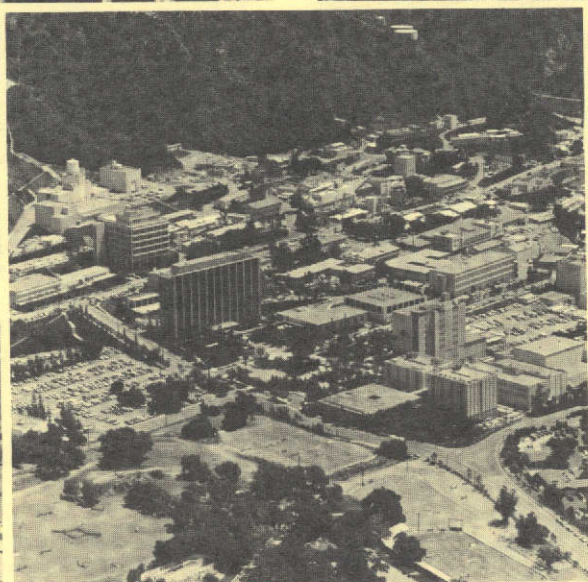
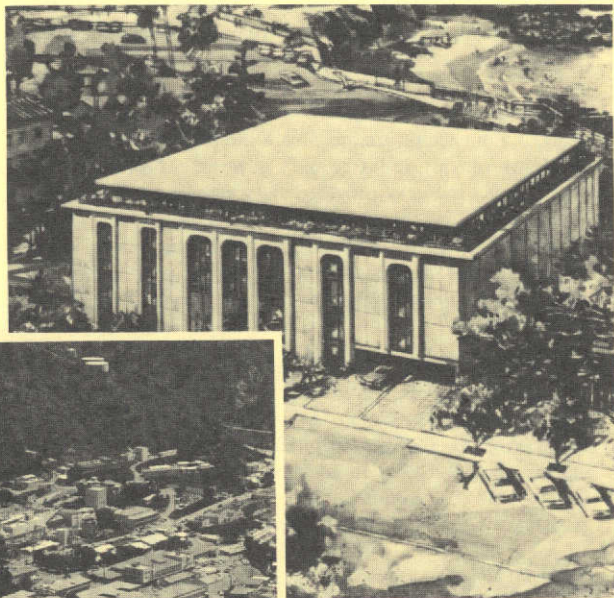
Northrop Corporation's prior interest in civil technology was primarily with materials and equipment, airport systems design, and policy communications. They worked on advanced housing systems, and have developed portable auto-emissions testing laboratories and Ecolog, a noise-level monitoring and display system now installed at the Orange County Airport. Their Electro-Mechanical Division is located in Anaheim.

Bill Armstrong brought wide engineering and management experience with him to Anaheim. A voluble, high-energy Brooklynite with a strong sense of humor, open willingness



*Facing: Four cities advisors with JPL Principal Investigators, City and Company Managers, Spring 1972. Above: Fresno Advisor Licciardello with Mayor Ted Wills.*







to be helpful, and great skill as a cartoonist, he had run space and aircraft projects and, recently, managed Northrop's Engineering Mechanics subsystems for a JPL/NASA mission to Mars.

Science Applications, Inc., a young high-talent firm interested primarily in advanced and systems-oriented research and development, embodies part of its civil-systems background in the collective prior experience of its technical staff. They have developed techniques for pollution detection and computer modeling of complex civil problems, and have studied radioactive and solid waste disposal and recovery, criminal justice systems, and river and air dispersal patterns. The company also served as a consultant in the reorganization of the National Institutes of Health.

Mike Licciardello moved to Fresno and took over his duties as Advisor in the autumn of 1972, bringing with him a background in aeronautical and nuclear engineering and management, and recent research experience in the field of technical manpower utilization, an aspect of the technology transfer problem. A friendly, articulate Bostonian with a Harvard degree and training in management and finance, Mike brought a well-developed social sensitivity and skill in bringing people together to the Fresno portion of the Four Cities Program.

North American Rockwell's Information Systems Company, located in Anaheim, had conducted Civil Systems efforts in transportation and education for the State of California, in water quality for the San Francisco Bay Area, and in communications, traffic management, and other areas for a number of cities in and outside the state. Because of a conflict between company policy and the restricted funding and contracting arrangements of Four Cities North American did not take up this project. However, the company placed an Advisor, John Glascock, in Anaheim, and continued to support his activities there in Cable TV procurement and other matters, without compensation, through 1971.

TRW Systems Group came into this program with civil systems experience in regional planning and government studies, traffic control and housing. Earlier TRW projects had involved Fresno, including development of the Com-

munity Analysis Division there. The company remained a part of the Fresno project team for a year, supporting a variety of technical studies on quality-of-life problems. TRW's Advisor to Fresno, Jim Wakeman, was interested in environmental problems, and worked this interest into a number of city activities, including a citizens' group, the Environmental Communications Network, and smog and pollution-abatement projects. However, a combination of his evolving interests, the company's changing goals, and several minor factors, led to their withdrawal from the experiment in mid-1972.

The Jet Propulsion Laboratory, whose role was to manage, coordinate, and evaluate the Program, and to provide technical help to the four city teams when needed, had several years experience in the transfer of technology between the space and military programs and to the civil sector. Much of its Civil Systems experience was in hardware systems, such as new transportation modes, Solar energy applications, medical technology, and communications equipment. The Laboratory had also conducted an urban housing system study, air pollution studies, an experiment in systems-technology transfer to school planning in Pasadena, and it led to a joint city-county study of urban growth in San Diego.

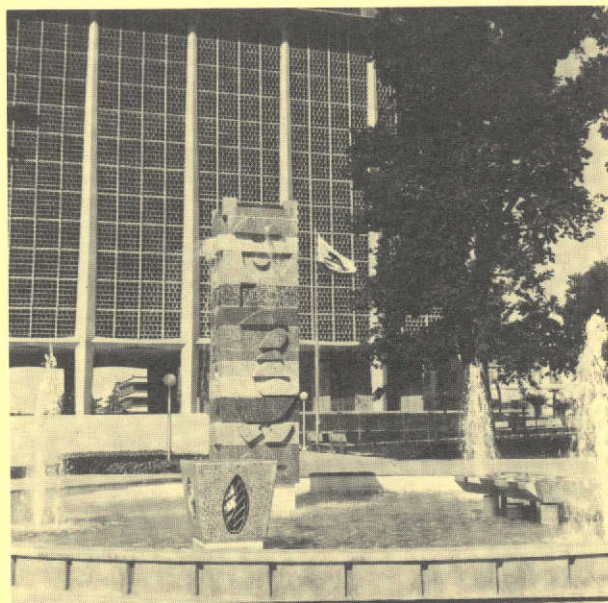
#### Four California Scenes

The cities which are participating in this learning experience are typical in many ways. Each city is big enough to have full-size problems, small enough to be able to know itself. Each is operating with a mixture of old and new equipment, techniques, and outlooks. Each is in the midst of social and physical change and growth.

Being in California, each of the four cities is within a short drive of natural beauty and man-made ugliness. Freeways and freeway construction projects quarter and surround each community. The government of each city is restricted in what it can do by the high capital cost of renovating or replacing outgrown facilities and services and the high operating cost of current operations. City services generally are a labor-intensive industry. City governments are the most vulnerable to the complaints and demands of the populace, and probably the most sensitive to possible effects of change. Yet each of the four cities is receptive to the ideas

*Facing: Corporate team—member facilities with JPL (center). Top left, Lockheed; top right, Science Applications; lower left, Aerojet; lower right, Northrop.*





put forward in the Four Cities experiment, and committed to the success of the program.

Anaheim began as an orchard town (grapes followed by citrus), and then became a residential community with the growth of the Los Angeles region. The opening of Disneyland in 1955 made it a tourist center, but at the same time light and medium industry were expanding in the city. This community has achieved a balance between residence, commerce, entertainment, and clean manufacturing. Virtually surrounded by neighboring communities, the city is growing principally in an eastern panhandle region along and above the Santa Ana river, with an industrial park, shopping centers, and hillside residential development. University of California, State College, and junior college campuses are in neighboring communities. Besides Northrop and North American Rockwell, the city houses a variety of industry in data systems, high-fidelity and communications, food processing and service, and household equipment. Besides Disneyland, the city has a major-league ball club in the city-owned

stadium, and a modern convention center. City government is dispersed between the downtown City Hall, a new police center, library, and fire headquarters, and some space in the Convention Center and the Anaheim stadium; a new Civic Center plan is being studied.

Fresno is the only one of the four cities to retain its historic role as an agricultural center. Founded just over a century ago as the market point for a rich vineyard region, it soon became a major railhead as well. Though it has sought a diversified economy, much of its commerce and manufacture is directly related to the economy of field, range and orchard. Lying within close range of three National Parks, Yosemite, Sequoia, and Kings Canyon, Fresno is a tourist service center; a modern and well-made Community Theater and Convention Center add to the tourist attractions. An attractive commercial mall displays a wide range of city-owned modern sculpture. A campus of the California State College System is located in the city. Fresno is the County Seat; some 80 percent of the county's people are

The Cities	Anaheim	Fresno	Pasadena	San Jose
Foundation	1857	1872	1874	1777
Situation	Major community in suburban Orange County near Los Angeles	Seat and center of agricultural Fresno County	Dominates San Gabriel Valley in Los Angeles County	Seat of heterogeneous Santa Clara County, industrial center
Location:				
miles from coast	20	150	25	30
from Los Angeles	30	220	10	375
from San Francisco	440	190	410	50
Population	180,000 and growing	170,000 and growing	113,000, not growing	450,000 growing rapidly
Area	35 sq. mi.	45 sq. mi.	25 sq. mi.	140 sq. mi.

*Facing: City team members. Anaheim Convention Center; Fresno City Hall seen through courthouse arcade behind sculpture; Pasadena City Hall; San Jose City Hall.*



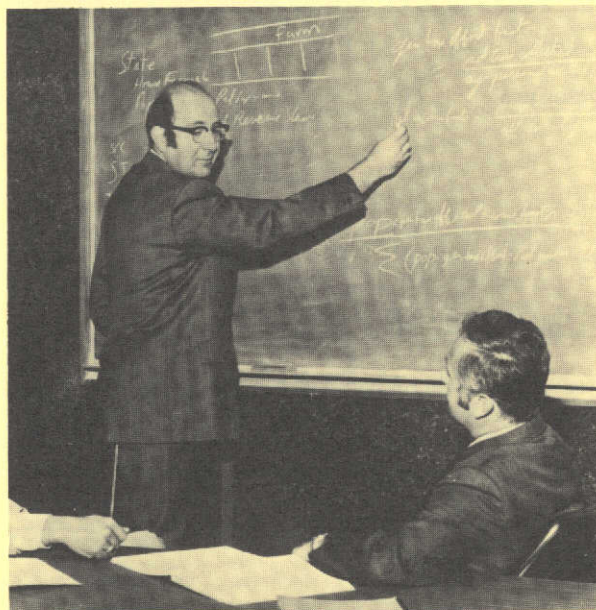
are situated in a downtown Civic Center, but the modern City Hall is already overcrowded. City government includes a Community Analysis Division, one of the first in California, organized with the help of TRW Systems and the encouragement of their City Manager, Bruce Reiss; this agency researches community views and other data. The community Council, a voluntary civic group, provides Fresno both information and other aid in community projects.

Pasadena is the smallest of the four cities, and is not expanding, but the Tournament of Roses makes it the best known nationally. Founded in 1874 at the feet of the San Gabriel Mountains, the community was a wintering place of the wealthy from late last century until World War II. Since then Pasadena has replaced orchards with neighborhoods, dairies with R&D plants, and mansions with condominium apartments. The area of the city is restricted, by surrounding cities and mountains, and as a partial result the population has not grown beyond the 1960 figure of 113,000. Largest employer is the California Institute of Technology, which operates the Jet Propulsion Laboratory and shares in the management of the Hale Observatories at Mount Wilson and Palomar. Pasadena is still in the midst of changing from an essentially residential and service community with seasonal tourist enterprise to a balanced economy of light industry, commerce, tourism, and residence; it is also moving towards a racially balanced populace. It has an extensive public library system and many sectarian and private schools and colleges, as well as an excellent public junior college. A new Convention Center is under construction, and the city government is housed in an old but graceful City Hall close to the commercial center and most other major city facilities.

The oldest, largest, and fastest-growing of the Four Cities is San Jose, seat of Santa Clara County and southern anchor of the San Francisco Bay Area. Established nearly two centuries ago as a Spanish civil colonial post near the Santa Clara, San Jose, and Santa Cruz missions, this city has become a major agricultural market, a transportation point, a manufacturing center, and a residential and educational community. The city has more than doubled its numbers since 1960, with a population reaching toward half a million. A major State College, half a dozen junior colleges, and private universities next door at Santa Clara and just up the Peninsula at Stanford, show San Jose to be rich in intellectual resources. An abundance of manufacturing industries, many

of them new research-oriented plants with a campus appearance, and commercial enterprises, many of them newly and attractively housed, reflect economic vitality. Quartered by freeways and served by an excellent freight rail net and a modern airport, San Jose is on the move. City, county, and other government offices inhabit a spacious and modern civic center. Yet San Jose's proudest claim is perhaps its major problem as well: rampant growth. A municipality is traditionally a responsible institution, providing mostly service. Growth of demand may be so rapid as to strain the ability to respond.

Thus the Four Cities Program found four cities similar in their maturity and willingness to consider new approaches, different in character and situation. All four are undergoing changes, of various kinds, trying to adapt and modernize a common tradition of government and service delivery in different ways. Each had some access to advanced methods and technology, but not enough; each had some general expectations that Four Cities' high technology could help with the job. Some were looking for devices and designs to solve technical problems; some had high hopes for computer operations; some intended to wait and see.







### Pattern for Progress

From the beginning, the style of technology transfer in Four Cities has been intended to be low-key and unobtrusive. "Technology," as a recent intergovernmental committee report remarks, "cannot be force fed." The fundamental mode of communication and interaction in the project is person-to-person. Conversations were found, as expected, to be more effective than memos. Meetings had more force than calculations. A report forwarded to a city department was not as welcome or communicative as the act of helping the same department write a report of its own.

Progress and change are often viewed apprehensively by those who must make or approve it. Science and tech-

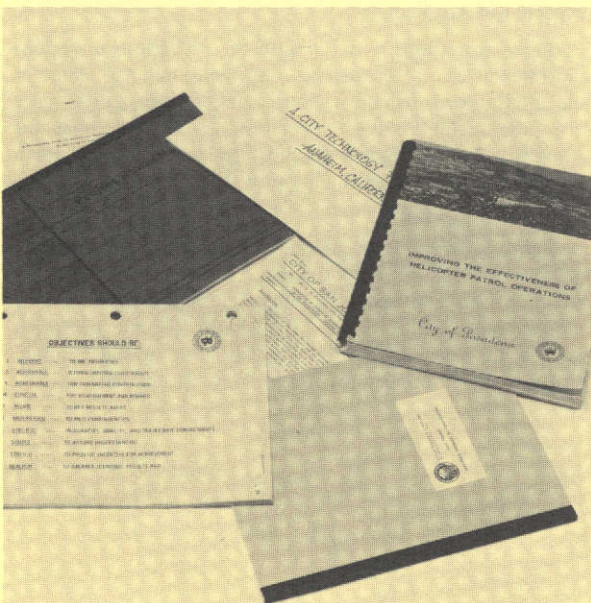
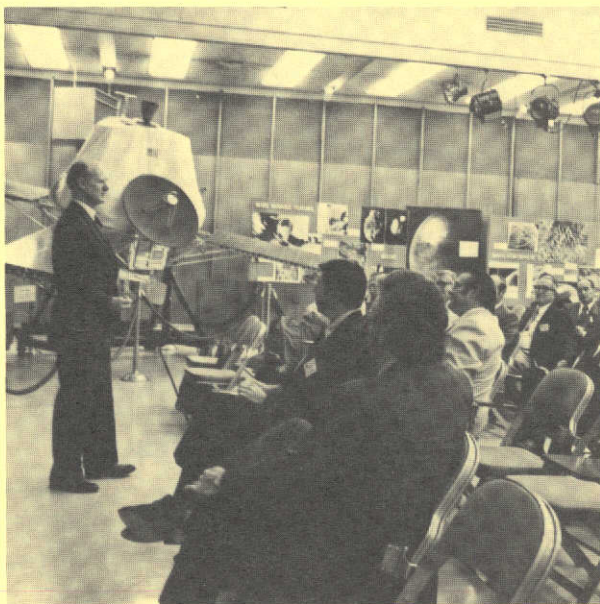
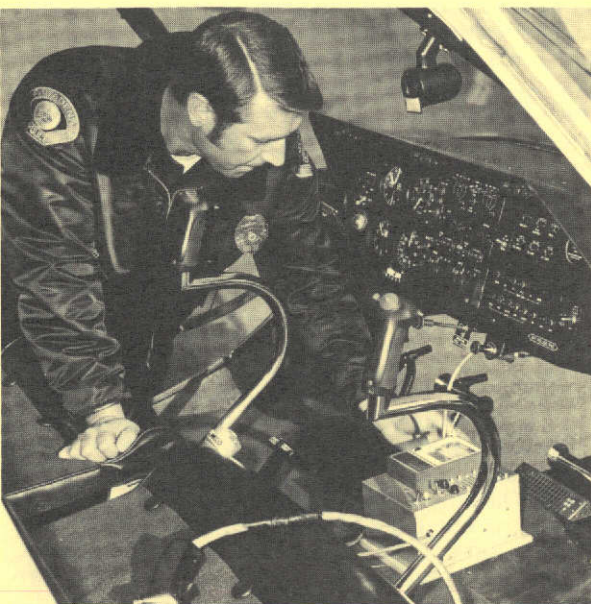
nology can present an unsettling if not dread prospect to many people, especially those in local government. One of the first tasks, therefore, was to reduce misapprehensions about some aspects of new technology, especially in management applications. At the same time the project had to clarify the positive value of applicable technology to city personnel, both by removing exaggerated expectations and making them aware of unsuspected possibilities.

A complementary activity in this learning phase of the project, on the part of the Advisors and their companies, was to find out the real scope and profile of city needs and problems. For example, Jerome Weiss in San Jose learned that, because of the struggle to keep pace with rampant community growth, the city had much less advanced technology in its service than its high-technology industry and modern civic-center architecture would suggest. Mike Licciardello, entering the traditionally rural city of Fresno, found a progressive, sophisticated and art-minded young metropolis with some advocates of high technology already at work in City Hall. Forest Warren found Pasadena with fewer benefits of advanced science and technique than the presence of Caltech and a number of industrial R&D establishments implied. Bill Armstrong found a greater use of advanced equipment and skills than he and Northrop had expected in Anaheim.

These conditions exist because of the various directions and rates of change in the cities and their ability to secure or allocate funds for technical change, and point up a divergence from the technologist's expectation. This underlines the thesis that any attempt to transfer high technology to urban management must be grounded in a thorough analysis of the particular urban environment selected.

One common feature of the learning process in the four cities was that the direct personal skills of the Advisors, whatever they happened to be, proved to be in demand and of immediate use to the cities. Men who had been expected to become brokers for high technology have found primary vocations in practicing the technology themselves.







### III. WORKING

Activities of the Four Cities Program exist on several levels, each with its own degree of visibility. They variously fulfill management, experimental, and development functions. Most obvious are the pilot projects, which are undertaken partly to focus the constructive efforts of city and company personnel (management), partly to demonstrate technology transfer in the Four Cities mode (experimental), and partly to advance the art of city management and bring specific benefits to the city involved (development). Next come the smaller-scale development tasks, which result from the introduction of a new set of skills into City Hall; examples include a brief technical study or system analysis, or the creation of a proposal or presentation. A principal focus of the experiment in technology transfer, though it is sometimes overlooked, is the constant presence of the Advisor as an example: his methods of fact-finding, decision, organization, and communication, reinforced by his company associates provide a working model of new technique. Finally, an important management function of the Four Cities experience is the communication and sharing between cities of their innovations in the Program; this phase, difficult to carry out and dependent on other developments, has matured very slowly.

The working conditions of the four city teams have been very different. Three of the Advisors are physically located in, and in varying degrees associated with, research-oriented staff departments in their respective city governments. The fourth, though located outside City Hall, has a close working relationship with the Executive Assistant to the City Manager, who is active in development and planning. Development of adequate working conditions took longest in Fresno, where the first advisor was housed in leased space outside the Civic Center; the present Advisor is situated with the Community Analysis Division and is close to the City Manager's staff departments. The degree of interest shown by elected officials is vital to some Program activities; San Jose's Mayor Norman Mineta was first in this respect, and the leaders of the other cities, Mayor Yokaitis of Pasadena, Mayor Dutton of Anaheim, and Mayor Wills of Fresno have shown increasing public commitment to Four Cities.

#### Focus on Technology

In each city this Program began with efforts to survey and define problems which technology might solve. Jerry Weiss, for example, spent most of his initial "learning phase" in San Jose on thorough survey of the city's problems. In Anaheim, each department produced a list of needs and requests. This experience produced studies and advice on how to establish priorities and methods of identifying problems as such, but the primary purpose was to select pilot projects to be conducted in each city.

The possibilities for civic use of cable television were considered in three of the cities. Anaheim was preparing a CATV ordinance at the time. North American's John Glascock, helped by JPL and consultant Irving McMurren, conferred with the city departments which could benefit from such a communications system. The team prepared a new CATV specification for the city, and rewrote the franchise ordinance to reflect the expanded features, including wideband data and communications channels between city facilities as well as emergency communications to city subscribers. This has become a model ordinance in the CATV field. Bill Armstrong picked up and completed the effort. The Four Cities project team advised city personnel on procurement and selection techniques; Anaheim selected and authorized Theta Cable to create and operate this system, when FCC approval has been obtained.

Fresno granted a CATV franchise in 1966, but FCC approval was not forthcoming; the matter was picked up as a Four Cities project. Three channels have been set aside for public, local government, and educational use. Fresno is ideally situated for such a system in that it is a large concentrated community, out of range of the major TV sources. The Advisor has been working with local government and with the Fresno Community Council to increase public consciousness of this facility, with the eventual objective of organizing citizens' groups to help guide the use of the public-access channels.



The ultimate prospects of cable television are almost science-fictional, for this wide-band wired communications network could eventually offer the possibility of two-way communication, automated meter reading, fire and burglar alarms, and even Big Brother-like surveillance, as well as its current functions of improved home entertainment and education and data links between public facilities. Different cities and technical experts have conflicting views and approaches toward this system; the extreme possibilities are separated from us by some years of study and engineering.

Pasadena has gone to considerable trouble and expense to acquire a police helicopter patrol to increase the effectiveness of the police and fire departments. But the two helicopters had to be housed and serviced 22 miles out of town at Brackett Field, reducing patrol effectiveness to about one-



third of total time. A temporary refueling point next to the Rose Bowl could provide little more than emergency service. The Advisor, Forrest Warren, collaborated with various city departments to conduct a heliport site survey in the city, with a goal of increasing availability of the machines to 90 percent of the time. A prospective site was found in

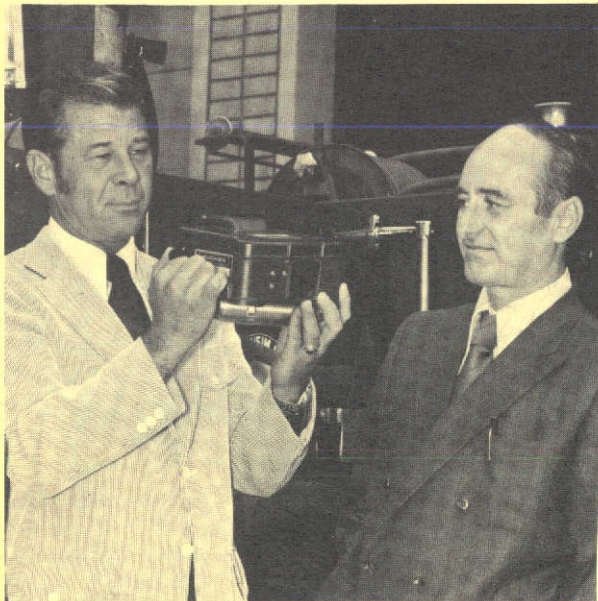
northwest Pasadena in a broad corridor cut for the new Foothill Freeway. A cost survey indicated this could be relatively inexpensive choice, since the proximity of the freeway had already cleaned the area. A noise survey conducted by JPL engineers, suggested that heliport use should not significantly exceed noise levels anticipated when the freeway comes into full use. Notwithstanding this finding, protests and legal action by a citizens' group have delayed implementation. Advisor Warren also supported a proposed cooperative regional use agreement for the patrol, designing and constructing a flight logging instrument for determining the amount of patrol and response activity devoted to each of the several neighboring cities during a survey period. In addition he contributed to the preparation of Pasadena's first flight manual, "Improving the Effectiveness of Helicopter Patrol Operations."



One item on the Anaheim Fire Department's technology want list called for ways of removing smoke in an urban fire so that one could see to rescue trapped victims and put out the fire. Bill Armstrong took this problem to his colleagues at Northrop, who developed a new statement of the problem:



if you can't remove the smoke, try another means of seeing through the smoke, such as radar or infrared. They found that a competitor, Hughes Aircraft, was adapting a military infrared viewer for possible civilian uses. Visits and demonstrations were arranged: the device, called PROBEYE, looked promising. The City Manager and his Advisor convinced the City Council of the value of acquiring this expensive but effective instrument. Anaheim placed the first order for PROBEYE, and received the prototype equipment for testing until their own instrument could be delivered. In tests with a burning building and in helicopter overflights it worked for the Fire Department, and the City's electric-power utility borrowed the device to examine their power transformers for possible overheating. Recently, as a result of Anaheim's pioneering work, Public Technology Inc. became interested in the Hughes PROBEYE and is telling other communities

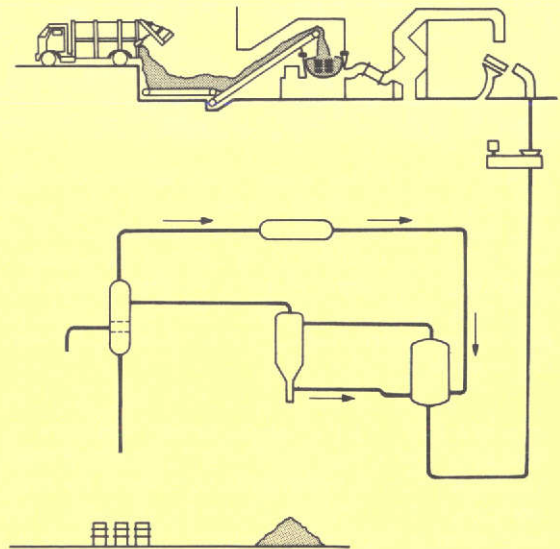


about it, and the City of Orange, not far from Anaheim, is studying possible use of the instrument.

Police cars and other city vehicles wear out and must be replaced after a reasonable term of service, which is often defined arbitrarily. Charles Ware, of Fresno's Public Works

Department, felt the economic, safety, and technical factors of this problem could be gathered into a mathematical model: a proper Four Cities task. After he had conceptualized the mechanism, JPL programmed it as a computer model. It is in use in Fresno, and, with modifications, in San Jose; both cities have saved tens of thousands of dollars in vehicle costs as a result. Anaheim also studied the model, as have many cities outside the program.

After public safety and health, and perhaps before water and power and streets, waste removal is one of the most important of city services. Solid waste occupies space, is often noxious and attracts pests, and may contain valuable reclaimable materials. Fresno was particularly interested in waste management technology because its sanitary landfill is nearly full. Early in the Four Cities Program, Fresno's



Advisor contacted JPL, where the possibilities of pyrolysis (a furnace process) and other clean waste-processing techniques were explored. After Science Applications and Mike Licciardello joined the Fresno team, the company undertook a system analysis of the entire waste disposal process as applied to the Fresno region, including consideration of





applied to the Fresno region, including consideration of future growth. Licciardello broadened the study program and, through the assistance of NSF, discussed the problem with the Union Carbide's Linde Division, developers of a proprietary oxygenation process. He organized a regional Solid Waste conference, bringing in Fresno City and County officials and representatives of the regional Council of Governments.

At the meeting in July 1973, Science Applications presented results of their study, dealing with a variety of separating, compressing, and chemical processing techniques yielding a variety of useful products, as well as the economic strategies. Two JPL presentations dealt with different methods of processing water-borne solid waste, such as sewage and certain industrial waste forms found in Fresno. Union Carbide representatives described their firm's oxygen refuse converter, which produces clean-burning fuel gas and slag-like residue. The conference involved regional agencies in the beginning of a continuing cooperative attack on solid waste problems and solutions.

Automatic data processing is a technique which has grown in both demand and capability in recent years; it is one of the

most important high technologies for city management. As they expand and change, cities leave far behind the traditionally acquired information bases which support decision-making. Increasing numbers of taxpayers and service customers, complex police and fire-protection operations and responsibilities, and the growth of the city government as an institution, make it imperative the city administrators have accurate, complete information, processed and distributed quickly. San Jose, with its rapid growth, was the best candidate for such advanced technology; Lockheed and Jerry Weiss were highly qualified to help the city meet this need. The City Manager established an interdepartmental Elec-



tronic Data-Processing Coordinating Committee, with Weiss as chairman, to review the needs of all parts of city government and the capabilities of existing systems and equipment. The Committee meets to consider alternatives and new methods, and plan towards an integrated Municipal Information System. They have retained a consultant for the Information System study, but most of the work is being carried out by city people with training and technical assistance from Lockheed.

In management training and support, each city team was highly productive, demonstrating that management

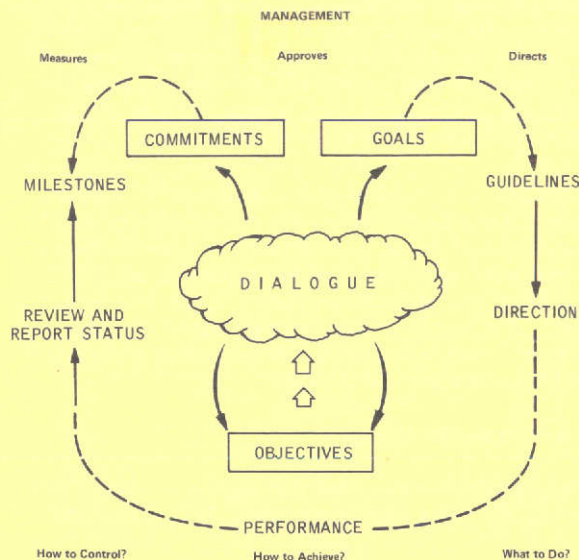


methodology is an important area for transfer from the R&D industry to city management. In San Jose Jerry Weiss instituted a series of new-technology seminars for supervisors and staff, led by Lockheed specialists. Subjects range from laser communications to decision theory and time management.

In Anaheim, Bill Armstrong began by putting up schedule/progress charts in a few staff offices. These simple large forms display in workable, changeable form the status of city development and research projects, and help stimulate a systematic approach to problems. City Manager Keith Murdoch asked him to set up a city program control center. Armstrong got permission to install the management control room in the city's underground disaster control site, which had previously been essentially a reserve facility, withdrawn from day-to-day operations. Now, regular city staff meetings, project reviews, and planning sessions are held there, surrounded by status boards, equipped with projection screens Bill built with his own tools.

Mike Licciardello has created an internal status-monitoring system as well, but his medium is the report rather than the wall chart. Fresno had balked at a previous

### *Management by Objectives Process*



proposal to establish a complex, expensive, computer-based management information system; he found a way to provide the benefits bit by bit without the strains of starting all at once, using a flexible quarterly status report. The Fresno team found the initial issue of the report a valuable experience in defining and organizing city activities to fit a common project format. With subsequent issues the city's Development Department is taking over the publication responsibility, while Mike expands the report from the 200 activities already covered. It can grow toward a general municipal information system as Fresno develops the need for this more sophisticated management tool.

It is in Pasadena that Four Cities has had the largest and most well-received impact upon the management process as such. Pasadena's major technology project involves something called MBO. Management By Objectives is a communication, training, management, and reporting method whose result is a series of constructive, confident relationships between levels of management, a motivated staff, well-informed executives, and a program approach to tasks and plans. MBO was introduced in Pasadena with a group of management seminars conducted by Aerojet, followed by planning sessions to work out the 1972-73 objectives. Training courses and counseling, also provided by Aerojet, prepared the supervisors to build the system into their department and office management. As applied in Pasadena, MBO provides that each manager negotiates with his subordinates the resources, and capabilities, in terms of explicit projects and tasks. Like Anaheim's schedule displays and Fresno's status reports, it provides a formal structure, chronologically, organizationally, and casually, for the planning, accomplishment, and evaluation of work. But MBO goes further: by requiring repeated mutual participation in successive tiers of supervisors, it provides motivation and a learning experience as well. Managers' comments indicate that employee awareness of department functions, organization of work, and the managers' understanding of departmental problems were improved. Hearing of Pasadena's experience a neighboring small city, Glendora, has requested a seminar on the subject.

### **Day by Day**

At the same time as the larger structured projects and between them, the Advisors handle a variety of smaller matters, each in his own way. Each has a distinctive style and



approach, learned in industrial and research management, applied and communicated to city administration.

Bill Armstrong of Anaheim assumed a roving commission. Working closely with the city's Research and Budget Department, and a regular attendee at the City Manager's Staff/Department Head meetings, he was in close touch with what was going on in the city. With a wide acquaintance at Northrop and JPL and around the industry, he could broaden the city's sources of information and advice. Bill turned his drawing skill into a promotion of effective internal communications and presentations, and his fluency with the written word put him in demand to help out with proposals and reports. He was able to interpret and explain computer models of various kinds and help city departments study and try them out. He helped a team from Harvey Mudd College apply the Forrester urban-growth forecasting model to Anaheim, tried JPL's site location model (by hand) on the location of a branch library, and worked with the city's data-processing and communications committees on system integration.

Forrest Warren regards his role as partly that of a management consultant/troubleshooter. Like Armstrong, he is a strong advocate of graphic presentations — he helped Pasadena to get low-cost, effective graphics equipment. He has helped the police department study, prepare, and present proposals for staff increase and desired ordinances, as well as aiding them in helicopter matters. He also tried a JPL mathematical site-location model and other approaches to fire-station location, observing that public interest and the social issues involved in this problem (like the heliport location) can be so great as to overwhelm the factors considered by an abstract model, rendering it almost useless in some cases. In addition, Forrest advised the city on peak-power generating equipment and other technical matters.

Although he has long been an Instructor in Stanford's School of Engineering, and organized an extensive management seminar program for San Jose, Jerry Weiss is teaching city administration even more by example. He treats each matter as a miniature project with defined objectives, form, and procedure, and approaches it in scholarly style. For example, considering the problem of establishing priorities for city efforts, he searched the literature for a theoretical model which might rationalize an otherwise subjective choice. The one promising technique turned out not to be

ready for application, providing the lesson that the necessary technology isn't always there. For the review of police-vehicle replacement policy, he assigned the preliminary analysis to a Stanford management student intern and his teacher. The intern program is successfully evolving from one of merely giving the students field experience towards their productive use in special projects and teams, and offers a potential model for new-technique introduction to cities with universities nearby. He also worked for the implementation of a unified distress-call system (phone 911), which is complicated by the non-coincidence of telephone and emergency-service jurisdictions in the San Jose area. In addition, Weiss has studied a management information system for city use, and the applicability of the Forrester Urban Dynamics model in San Jose.

The advisory approach of Mike Licciardello in Fresno is in between the consulting project expert role defined by Jerry Weiss and the roving trouble-shooter style practiced by the two Southern California Advisors. He speaks of "advisement" as a working professional discipline, giving a new institutional maturity to the primary Four Cities activity. One continuing activity of Mike's deals with the county-wide Council of Governments, to which Fresno as the sole large-size member has a delicate problem of relation. The Advisor has drafted city position papers on regional relations, brought cities and county together over the regional problem of solid waste management, and worked on policy proposals to further intergovernmental cooperation. In addition he introduced sound-level instruments to improve enforcement of a noise ordinance, instructing city personnel in their use, organized planning seminars for city officials, and helped evaluate proposed organization changes.

Thus in each of the four cities a small number of explicit demonstration projects, defined and implemented by mixed city-and-specialist teams, is augmented by a running series of varied tasks, some requested by the City Manager, staff, and departments, and others initiated or added to by the Advisor. The success of these routine support activities or mini-projects may be measured in the increase in requests by city officials for support of this kind.

### **The Medium and the Message**

Having helped conceive and then organize the Four Cities Program, JPL had a triple role to play. As "experimenter,"



the Laboratory held a watching brief, observing the progress, and through Dr. Brighthouse, the psychological development of the situation in each city. As "coordinator," JPL's project office organized and participated in the Quarterly Reviews, which served as the main channel for sharing and comparing experiences from one city to another, and for evaluating the progress during each period. As "technical support," Laboratory personnel were consulted and did work to help in a number of pilot projects and other tasks of the various project teams.

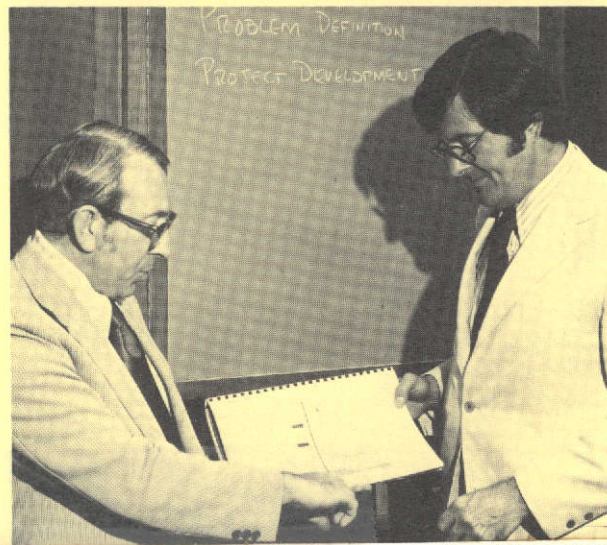
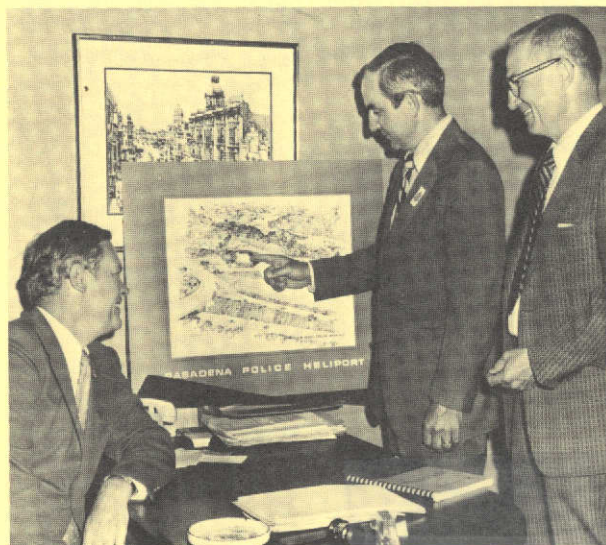
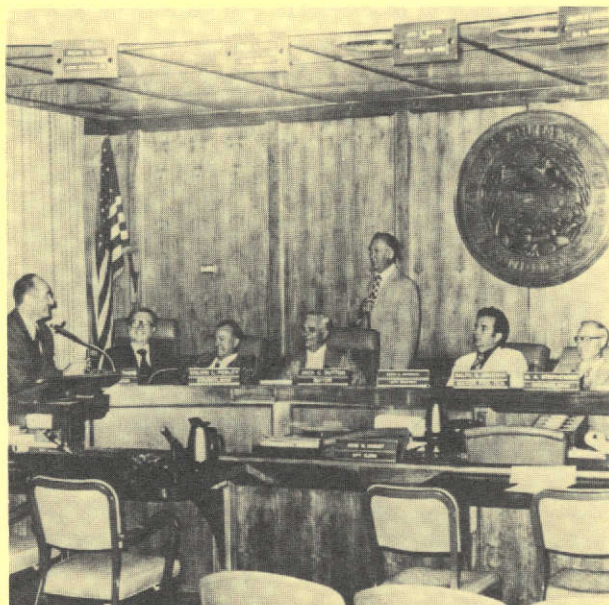
These partly conflicting roles developed unequally as the Program went forward. Although the two northern and two southern Advisors maintain irregular regional communication, coordination and communication within the Program generally seemed to languish except at the quarterly meetings. After the Spring 1973 meeting, the four City Managers – Keith Murdoch, Bruce Reiss, Don McIntyre, and Ted Tedesco – and the new JPL Principal Investigator formed a Policy Board for the program, to improve inter-city communication and collaborative planning. In addition, JPL actively joined, and thus increased, the informal communications among Advisors. A series of work sessions were held with the four city teams and JPL, working relationships were established between the Program and the Science and Technology Advisor to the Governor of California, Earl Davis, and with the City of Los Angeles Science and Technology Advisory Committee, various tasks and pilot efforts were brought forward successfully, and the city officials expressed new support for the aims of the Four

Cities Program. The project function as a medium for the steady exchange of new ideas from city to city has grown mostly in the last few months.



*Policy Board: James King, representing San Jose, and Anaheim's Keith Murdoch, standing; Pasadena's Donald McIntyre and visitor William Donaldson of Tacoma, Wash. Not shown: Fresno's Les White.*





Upper left, Advisor Bill Armstrong addressing Anaheim City Council, City Manager Keith Murdoch standing. Upper right, Advisor Jerome Weiss discusses information systems with San Jose's Mayor Norman Mineta, City Manager Ted Tedesco. Lower left, Pasadena Mayor Donald Yokaitis reviews heliport plan with Manager Donald McIntyre and Advisor Forrest Warren. Lower right, Fresno Advisor Mike Licciardello and Acting City Manager Les White review city project status report.



## IV. WINNING

As the Four Cities Program completes its second active year, it is evolving out of the experiment stage into development. Whether high technology can be transferred to city management in useful form is an answered question. What some of the successful approaches are, and what are some of the characteristics, limitations, and requirements of this process, are becoming the subject of reports rather than proposals. The program has moved to other goals: consolidating the process created in the Four Cities which participated, spreading it to other cities, joining with science and technology activities at the county and state levels. The spontaneous secondary transfer of Four Cities innovations to Orange and Glendora, and the exchange of techniques among the Four themselves indicate the maturity of the process.

Yet at the same time the process has been recognized as a slow one: not transmutation or revolution, but rather evolution is its model. The crucial process of change works well on a person-to-person basis, but the propagation throughout a civic institution is deliberate.

In the course of the demonstration, the Four Cities Program visibly transferred technology to city management field. That technology was light in the product category, heavy in that of processes. What we have called high technology is principally based in research and management process, though it has developed sophisticated supporting equipment. Many important city needs relate to the software, management technique, and other "process" functions, and the Four Cities Program was constructed on this basis.

### Clearing the Air

The Four Cities Program intruded upon a medium full of doubt and questions. The interest and needs of the city, on the one hand, and of the aerospace industry, on the other, were not generally agreed to coincide. Each institution's view of the other was clouded, and not necessarily favorable. The city could not be sure that the industry could really understand urban, social problems; the industry could not be sure that these even constituted valid problems as engineers and scientists define them. The innovative, process-based

approach of the Program, the open-minded attitude of the four cities' City Managers, and the extensive civil-project experience of the corporate participants both attacked such doubts and minimized their effects. Yet it must be emphasized that at the outset of Four Cities, representatives of the cities and of high technology virtually spoke different languages. A major accomplishment of the Program is that these people have learned each other's terms of reference.

However, some more specific doubts hovered over the program. City personnel were unavoidably apprehensive about introduction of a "senior professional" system management expert into their worlds, and the Advisors were naturally uncertain about their reception as outsiders. However, the tact and skills of the Advisors themselves, and good humor on both sides, gradually dissolved these difficulties. The concerns of the corporate partners cannot be met so easily, though. They entered the Four Cities experiment with a view to helping define a new field of endeavor for their industry. While each company certainly improved its reputation for expertise in this demanding field, and for civic-mindedness, none has yet found a profitable market for its skills and products. Northrop in particular must reflect wryly that it has proved something in finding a market for Hughes' PROBEYE. Yet the companies appear to believe that they are gradually opening a new field of urban service and management for the high-technology industry, and earning themselves places in it.

But the enduring response of the four cities in favor of the transfer process, however far it may be from market and products, suggest that the goal is being reached. One year into the Four Cities Program, two of the cities indicated that they would like to find ways to make the position of Science and Technology Advisor a permanent one when the Program concludes. Today even greater indications of support is shown in each city's offer of significant cash contributions to extend the Program.

Yet it is a realistic and balanced acceptance of high technology that the cities have acquired. They know that science



doesn't always give the answer you want, or an answer you can use, or even any answer at all. System analysis and the computer and the engineering manager constitute a new and valuable kind of resource for the urban community, not a magic elixir or universal solvent.

## Mission Results

The successful experience San Jose has had in dealing with data-processing contractors and consultants, and student interns, can be transferred to other city projects. Anaheim's newly-found expertise in source evaluation and selection for CATV and in testing and applying PROBEYE can be used on other contractors and other instruments. Fresno's access to technical experts on solid waste and use of formal reporting in certain management areas can grow to a broad front of technology-tapping and project control. Pasadena's experience of technical surveys in the helicopter project and adoption of a new management system show methods of getting technical assistance and introducing new techniques.

In Pasadena, the new Director of Libraries found that his subordinate managers and staff people were managing their activities with a coherent program of goals, plans, and capabilities: he could ask the people working for him where the organization was going, and get useful answers. In Anaheim the status of ongoing major projects need not be ferreted out, it is right on the wall. In Fresno even minor projects are codified, scheduled, and presented with their quarterly status in a published report. In San Jose, senior representatives of all the departments which use data processing sit down regularly and coordinate their evolving requirements, working steadily toward an integrated information system.

Two of the cities are well along toward Cable-Antenna systems which will serve the municipality as well as the networks. At least two of them exhibit more lucid and effective presentations and meetings, and therefore can plan, decide, and accomplish more and better. All four have learned that there are techniques of obtaining, mastering, and using technology, and the cities are acquiring and applying these techniques.

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## Never Enough

Now that the organic process of urban technology enrichment has been demonstrated, it should be applied more broadly. Similar system-level technology programs of various kinds have begun in individual cities such as Los Angeles, Philadelphia, Kansas City, Montgomery, Alabama, and Tacoma, Washington. Other cities and public agencies are viewing with interest the possibility of building a bridge across which to import new techniques and devices into local government. The former Science Advisor to the President, Dr. Edward David, Jr., sought and received a plan to extend the Four Cities approach to a national scale. And the groundwork has been laid to effect a linking between the Four Cities and the California State Science and Technology Programs.

The Four Cities Program thus has been its own breakthrough. Conceived to test a thesis which turned away from the fragmentary nature of earlier technology-application and technology-acquisition efforts, it has identified and demonstrated a method of cultivating the total process. Planting the seeds of high-technology awareness in four city halls, it has gathered a partial early harvest.

Yet it may have contributed to the genesis of a new applied art of social system engineering. The progress of the social sciences toward practical means of improving society has not been highly successful so far. But it is possible that this extended, purposeful crossing of the part-traditional, part-creative arts of urban social management with the applied science and technology of systems analysis and engineering may have a broader application. It could be the beginning of a new constructive understanding of modern society.



## DRAMATIS PERSONAE

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Ted Wills, Mayor of Fresno\*  
Donald Yokaitis, Mayor of Pasadena\*

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\*Associated with Four Cities in this position as of September 1, 1973



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p. 13: Pasadena Police Department.  
p. 14: Pasadena Police Department, JPL/NASA, JPL/NASA, City of Anaheim.  
p. 16: Pasadena Police Department, City of Anaheim.  
p. 17: City of Anaheim.  
p. 18: City of San Jose, City of Anaheim.  
p. 21: JPL/NASA.  
p. 22: City of Anaheim, City of San Jose, Pasadena Police Department, Fresno Police Department.